

NATIONAL TRANSPORTATION SAFETY BOARD

Office of Research and Engineering
Materials Laboratory Division
Washington, D.C. 20594



February 7, 2018

MATERIALS LABORATORY FACTUAL REPORT

Report No. 18-015

A. ACCIDENT INFORMATION

Place : Hallsville, MO
Date : September 13, 2017
Vehicle : Cessna 210G, N5960F
NTSB No. : CEN17LA352
Investigator : Mike Folkerts (AS-CEN)

B. COMPONENTS EXAMINED

Engine mixture cable

C. DETAILS OF THE EXAMINATION

The engine mixture cable was submitted with the wire strands separated, as shown in Figure 1. The two cable halves were labeled End A and End B, with End A associated with the longer length of cable and End B associated with the cable attached to the rod end piece. The separation of the strands was between the end of the rod end piece and a fitting on the end of the external wire wrap.

Digital microscope images of the wire strands of End A are shown in Figure 2 and Figure 3. Digital microscope images of the wire strands of End B are shown in Figure 4 and Figure 5. The fracture surfaces (red arrows) were flat and perpendicular to the axes of the strands. No necking or thinning of the individual strands consistent with overstress separation was observed.

Several wires were sectioned from End B and examined using a Zeiss Auriga 40 field emission (FE) scanning electron microscope (SEM). Figure 6 and Figure 7 show the fracture surface on one representative wire. There was some post separation impact damage around the outer circumference of the fracture surface. Feathery features consistent with fatigue were observed on the fracture surface. The black dotted arrows in Figure 6 indicate the direction of fatigue propagation, which appeared to emanate from the outer diameter of the wire. Striations (yellow arrows, Figure 7) consistent with fatigue were observed at high magnification. Pitting consistent with corrosion overlaid the fatigue features on portions of the fracture surface.

The flat fracture surfaces on the wires and their perpendicular orientation to the wire axes, the lack of necking or other deformation, and the fracture surface features

consistent with fatigue observed in the SEM all indicate the engine mixture cable likely failed due to fatigue.

Adrienne V. Lamm
Materials Engineer

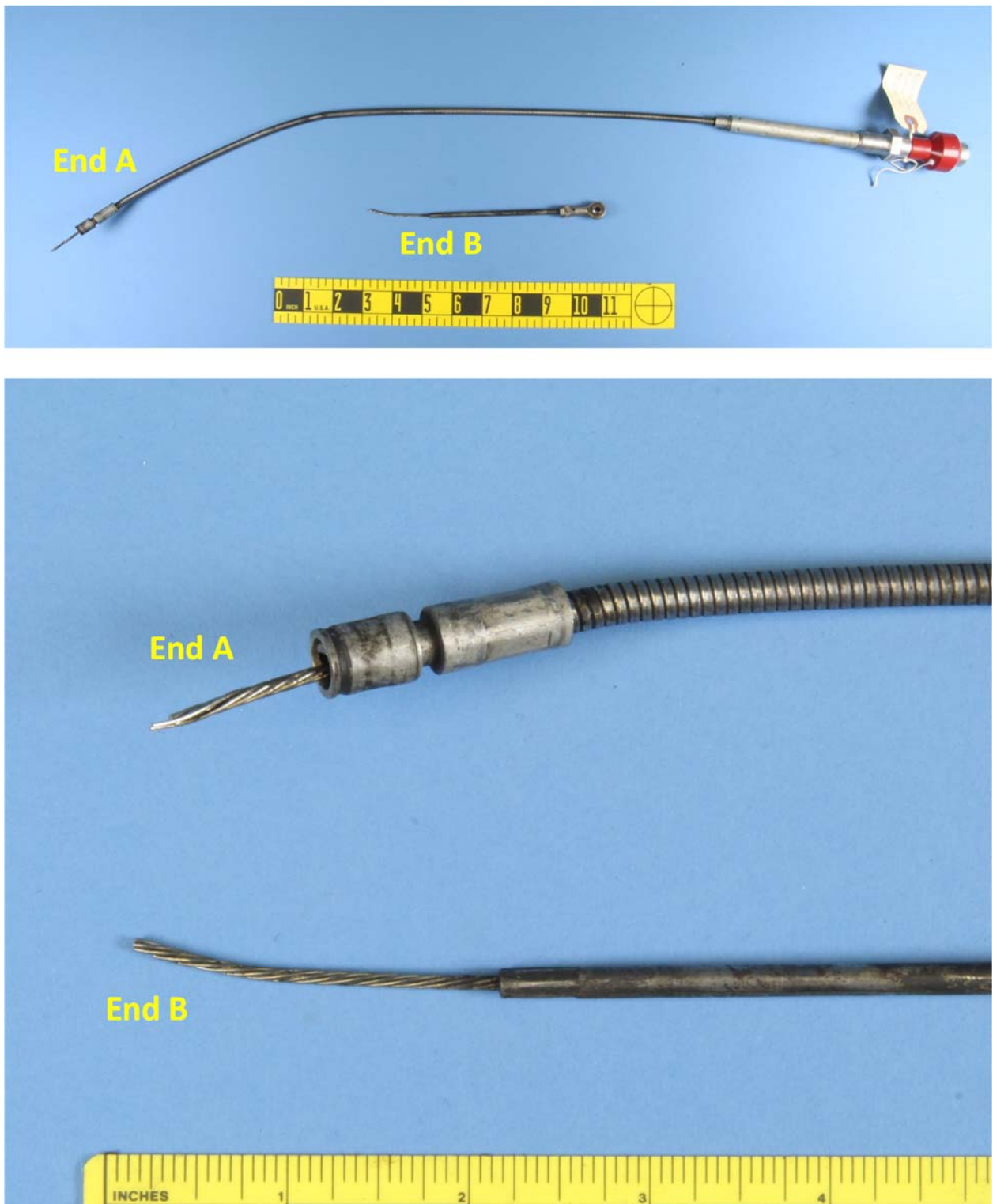


Figure 1: Overall (top) and close-up (bottom) photos of the separated ends of the engine mixture cable.

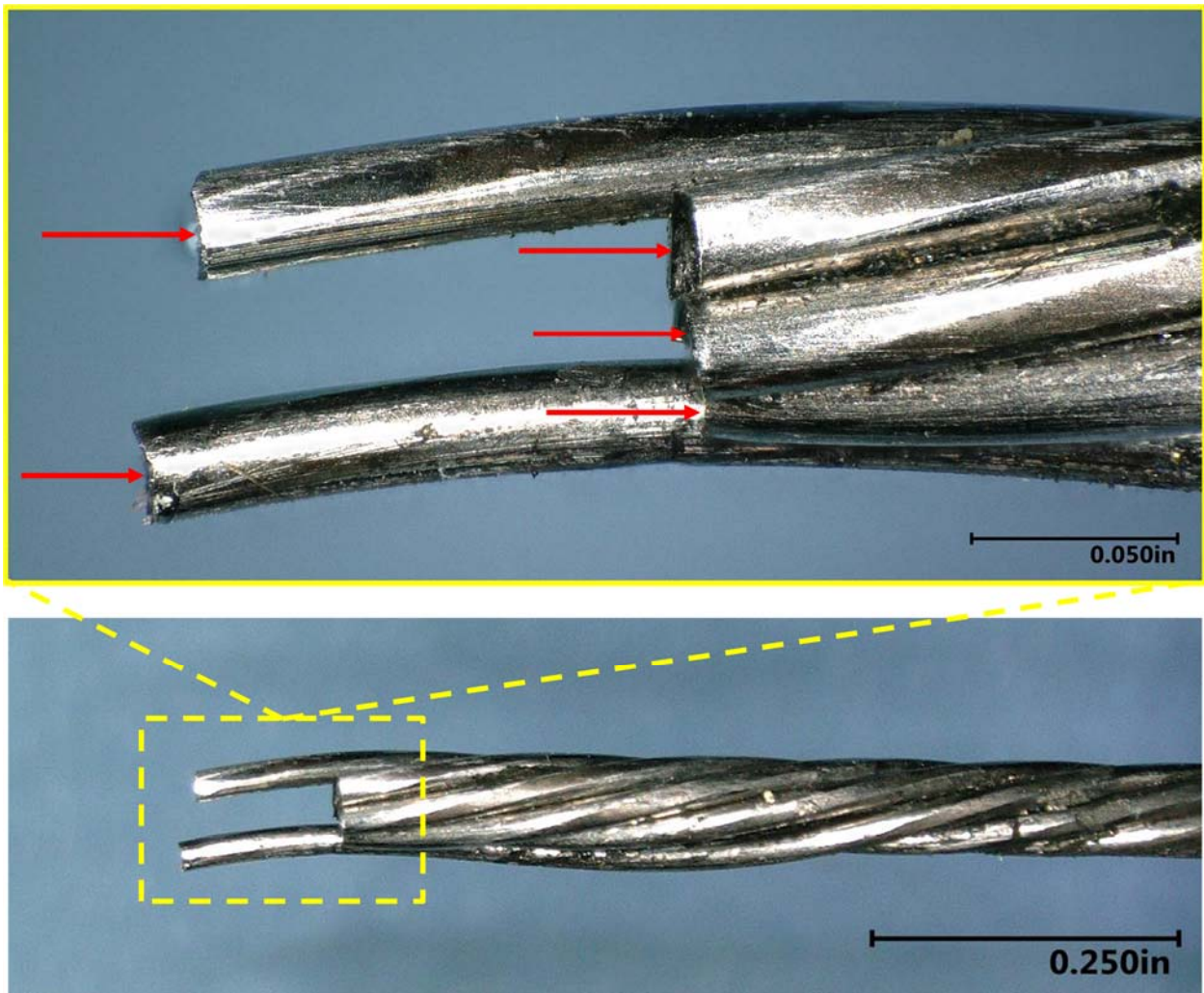


Figure 2: Digital microscope images showing a perpendicular view of the separated wires on End A. The red arrows point to the flat fracture surfaces on the wires.

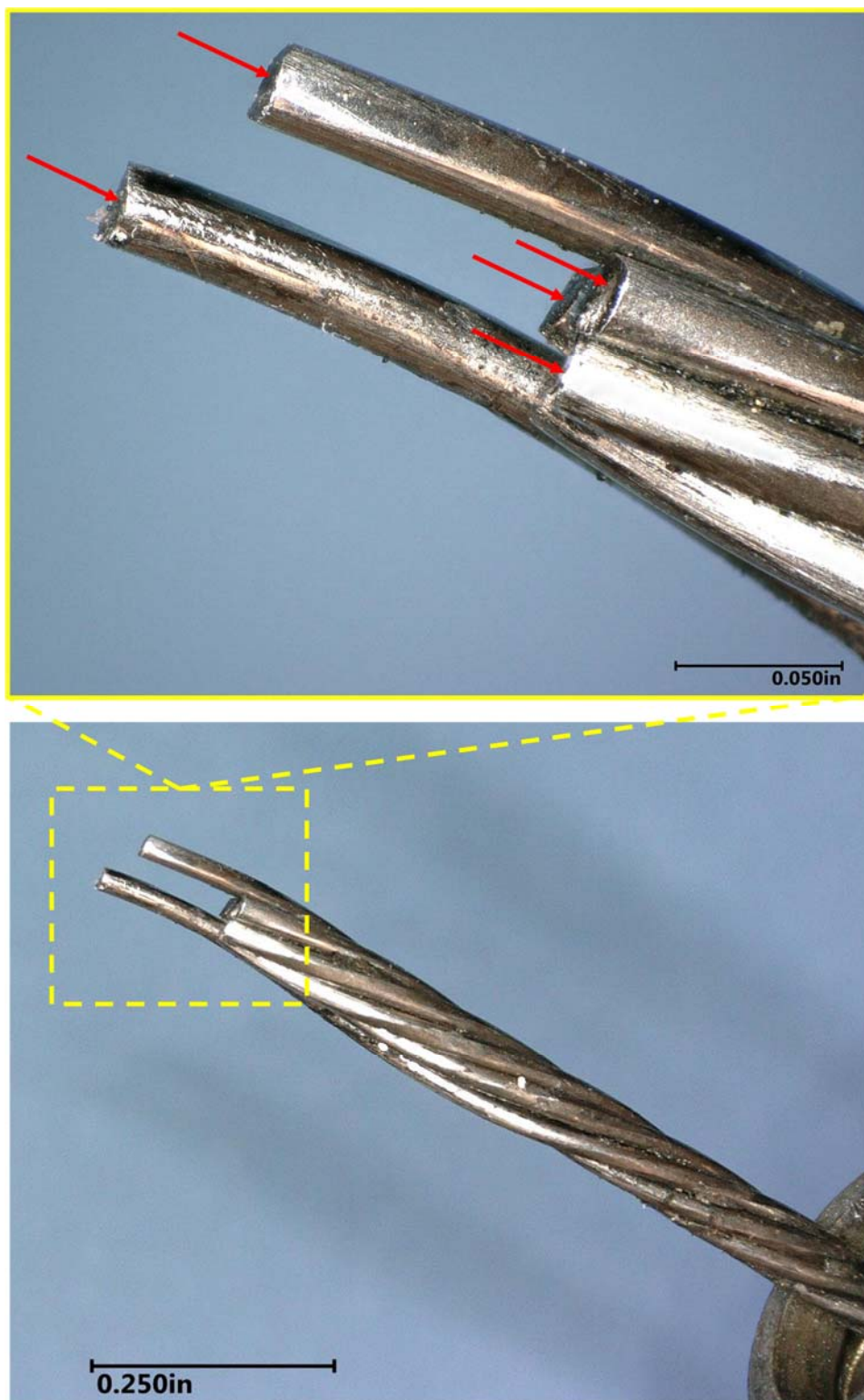


Figure 3: Digital microscope images showing an angled view of the separated wires on End A. The red arrows point to the flat fracture surfaces on the wires.

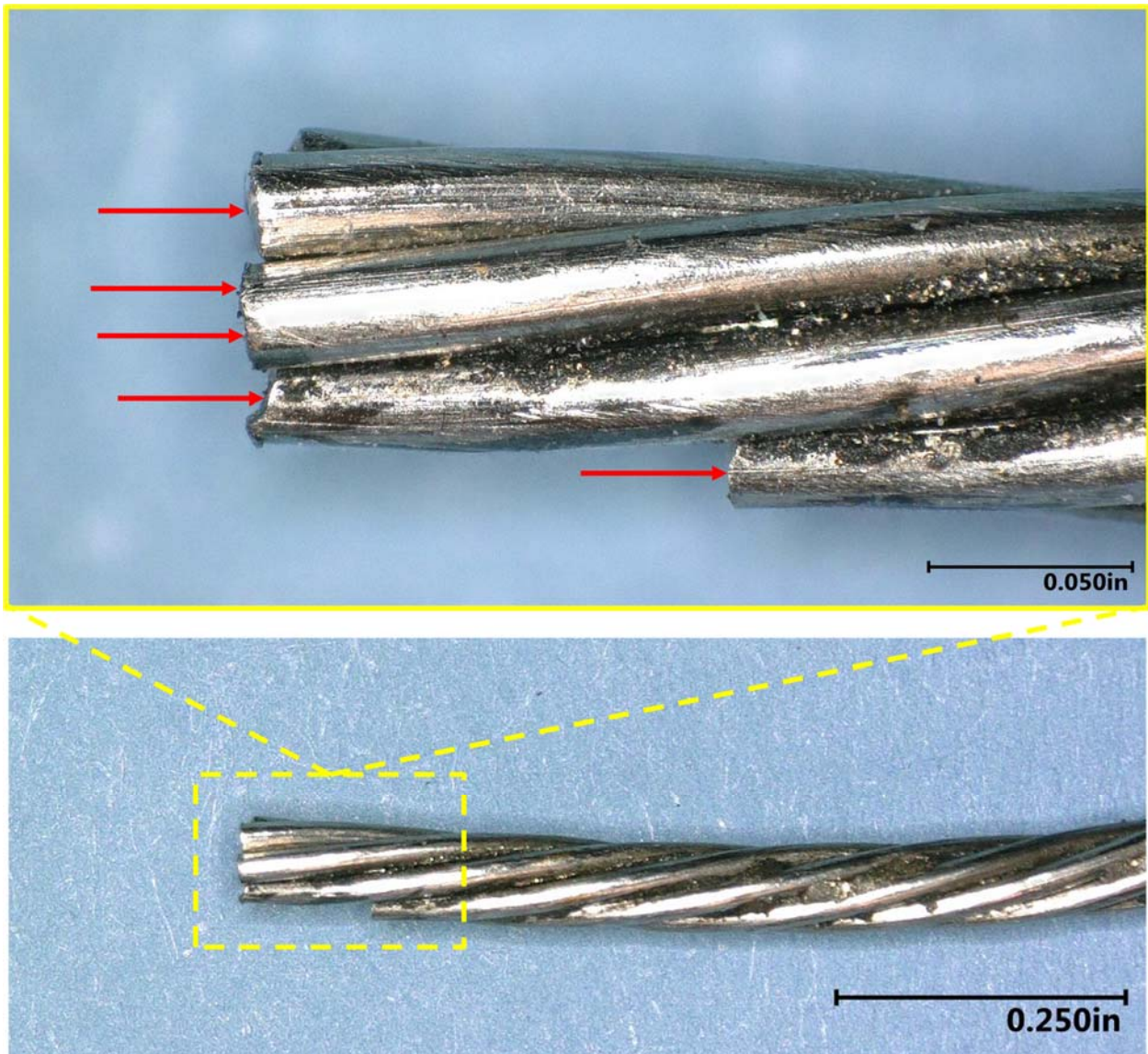


Figure 4: Digital microscope images showing a perpendicular view of the separated wires on End B. The red arrows point to the flat fracture surfaces on the wires.

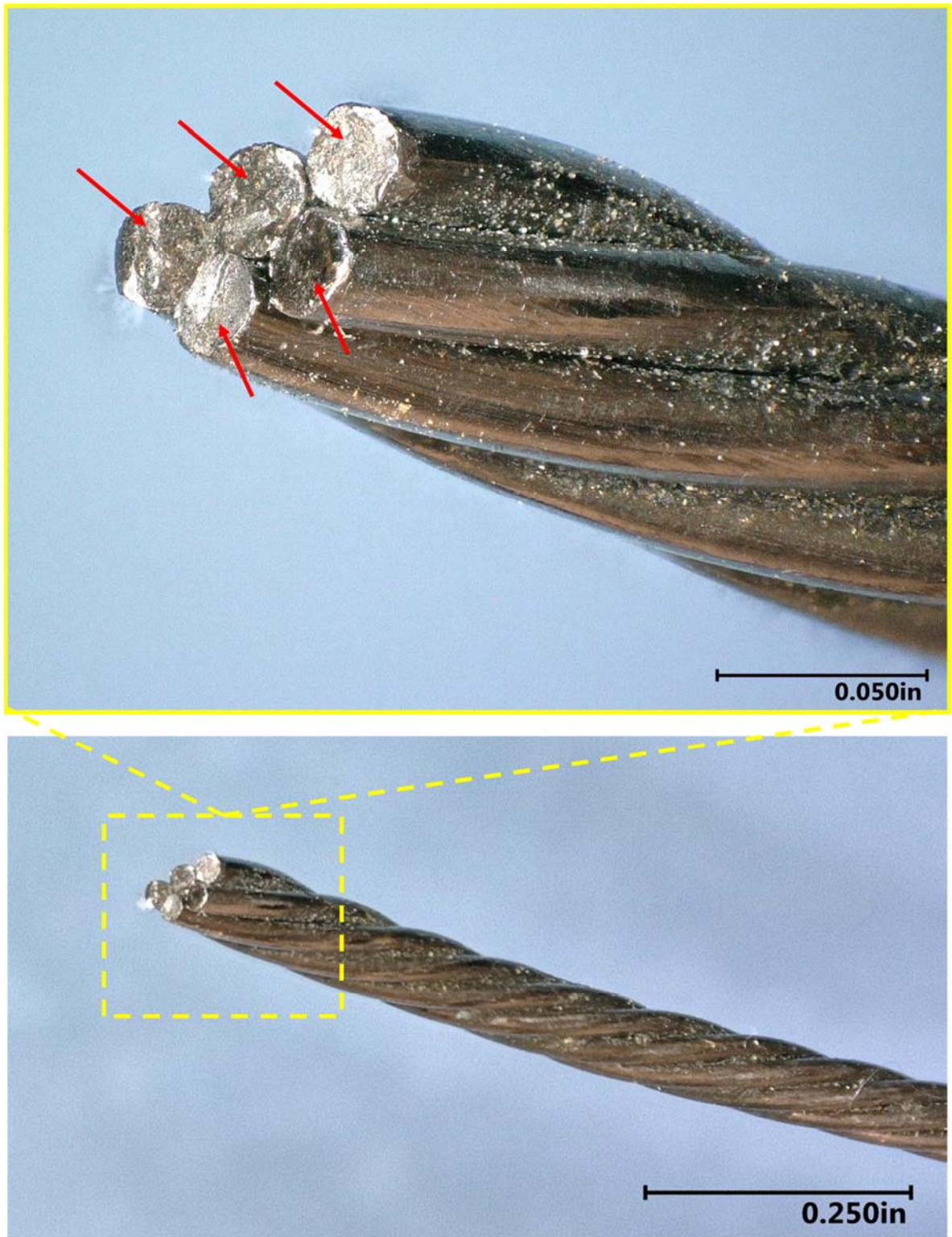


Figure 5: Digital microscope images showing an angled view of the separated wires on End B. The red arrows point to the flat fracture surfaces on the wires.

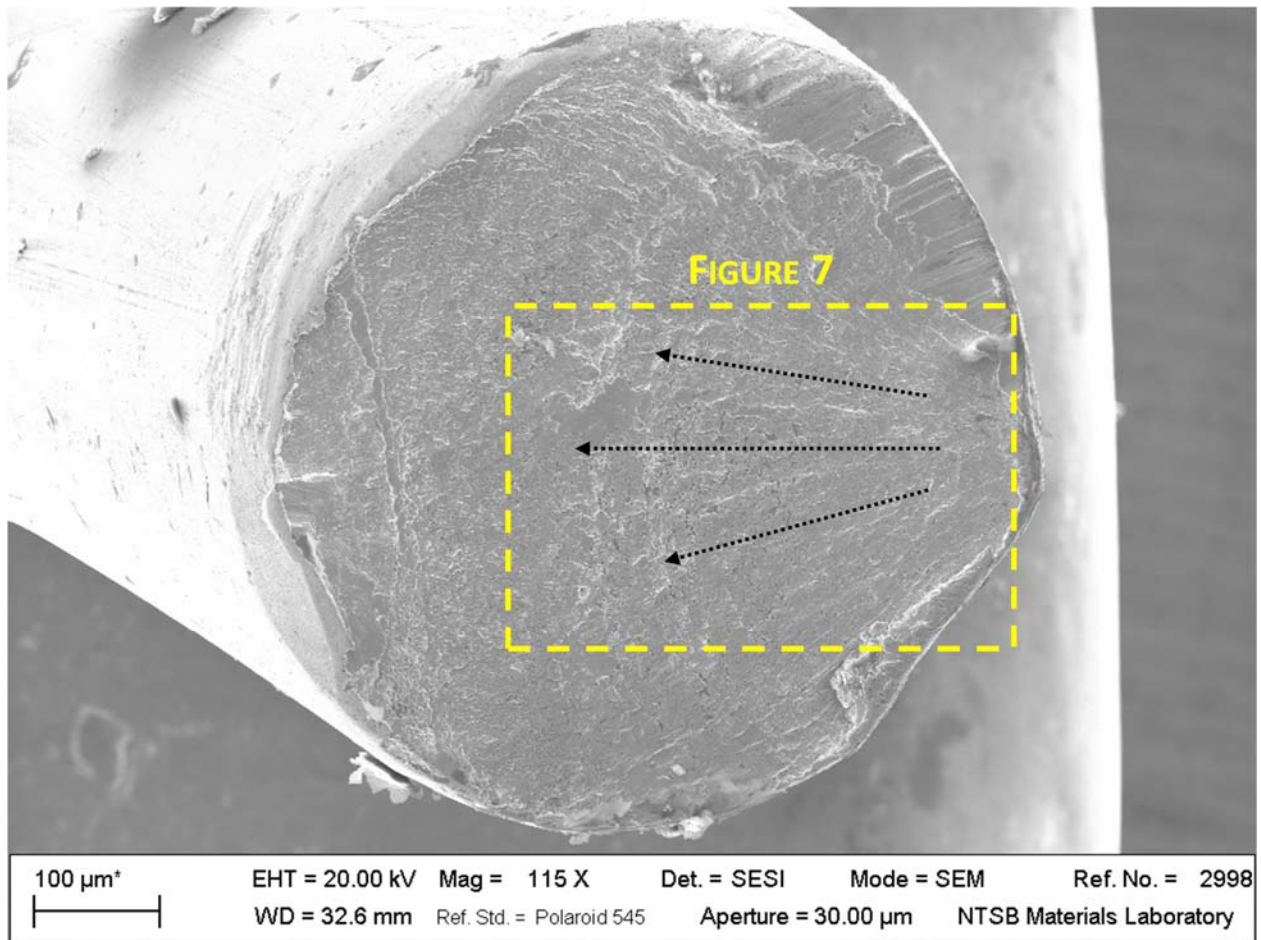


Figure 6: SEM image of the fracture surface of an exemplar wire sectioned from End B. The black dotted arrows indicate the direction of fatigue propagation.

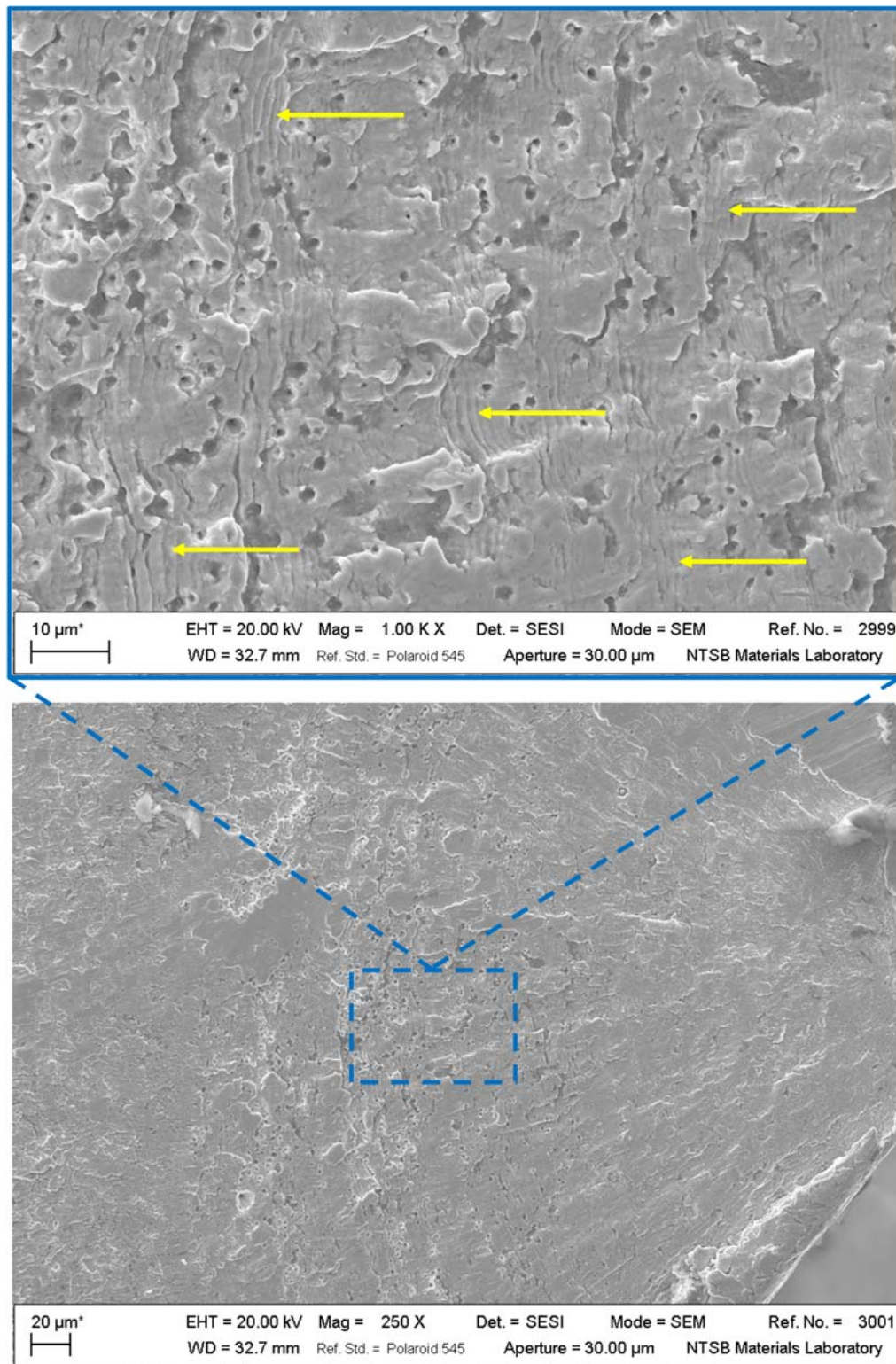


Figure 7: SEM images of the fracture surface of the exemplar wire sectioned from End B in the location indicated in Figure 6. The yellow arrows in the top image point to fatigue striations.